R&D PROJECT CARD

TYPE OF REPORT: Proposed Project

REPORT CONTROL SYMBOL: DD R and D/A/119

1. PROJECT TITLE: Aircraft Anticollision Trail Generators

2. SECURITY OF PROJECT: Unclassified

3. PROJECT NO.: 6666

4. INDEX NUMBER:

5. REPORT DATE: 3 Nov. 1958

6. BASIC FIELD OR SUBJECT: Operational Support Development

7. SUB FIELD OR SUBJECT SUB GROUP: Geophysics (570A)

7A. TECH. OBJ.: IO-14

8. COGNIZANT AGENCY: ARDC

9. DIRECTING AGENCY: AFCRC, GRD

10. REQUESTING AGENCY: Hq. USAF

12. CONTRACTOR AND/OR LABORATORY: To be determined

CONTRACT/W. O. NO.:

11. PARTICIPATION AND/OR COORDINATION:
SAC
TAC
ADC

13. RELATED PROJECTS:

14. DATE APPROVED:

15. PRIORITY: 1A

16. MAJOR CATEGORY:

17. EST. COMPLETION DATES

RES.	
DEV.	1961
TEST	
OP. EVAL.	

18. FY	FISCAL ESTIMATES
59	372
60	327
See P. 5 for Cont.	

19. REPLACED PROJECT CARD AND PROJECT STATUS

20. REQUIREMENT AND/OR JUSTIFICATION

Recent mid-air collisions, including that of two B-52 type bombers have resulted in serious losses to the Air Force both in trained personnel and aircraft. Studies of the causes of mid-air collisions have shown that the most frequent reason has been failure to see the other aircraft, despite the prevalence of good visibility conditions. The second most frequent reason has been due to misjudged distances and estimated rates of closure. Studies of two near misses involving USAF aircraft in the vicinity of L. G. Hanscom Field in the period from 1 June to

[illegible]

30 September 1958 have shown that they could have been avoided if a means of producing a visible trail had been in use.

The requirement, therefore, exists for a means of warning a pilot of other aircraft operating in his vicinity. This device would be useful under the following circumstances:

a. In flight, to warn one aircraft of the close approach of others.

b. In congested air control areas, to enable a pilot to see other traffic in his vicinity, especially during let-down and climb.

22. OASD (R&D)	BM.	CM.	C.	X.	L.	C.

DD FORM 1 APR 55 613

REPLACES DD FORM 613, 1 JAN 55, WHICH MAY BE USED.

1. PROJECT TITLE Aircraft Anticollision Trail Generators	2. SECURITY OF PROJECT Unclass.	3. PROJECT NUMBER 6666
	4.	5. REPORT DATE 3 November 1958

c. During refueling operations, to enable a tanker and the other aircraft to make visual contact.

The following design criteria should be met for practical use:

a. The device should be light in weight so as not to impose an unacceptable range penalty on the operating capability of the aircraft.

b. The device should be located in a position in which it will not impose a measurable aerodynamic penalty on the aircraft.

c. Insofar as possible, standardization should be achieved among various types of aircraft.

d. The device should be readily producible for installation in necessary aircraft in a minimum amount of time.

e. The device should be effective in acting to reduce the probability of collisions.

Reference letter from Hq. USAF-AFDRQ, dated 14 October 1958, subject: Aircraft Artificial Contrail Generator.

21. BRIEF OF PROJECT AND OBJECTIVE

a. Brief

A device will be developed which will produce visible trails. It will be effective as an anticollision warning device without imposing a penalty on the primary mission of the aircraft in which it is installed.

b. Approach

The approach will involve initially the development of a titanium tetrachloride generator for aircraft use. Although this device seems adequate as an interim solution, work will be conducted on the production of improved trail forming chemicals and on the problems of improved aircraft anticollision devices.

R&D PROJECT CARD
CONTINUATION SHEET

SECURITY CLASSIFICATION

1. PROJECT TITLE Aircraft Anticollision Trail Generators	2. SECURITY OF PROJECT Unclass.	3. PROJECT NUMBER 6666
	4.	5. REPORT DATE 3 November 1958

c. Tasks

(1) Airborne Generator Development

Effort will be contractual and in-house.

Trail generators for aircraft installation will be developed and tested. Design of a titanium tetrachloride generator will have first priority. This equipment will be designed to fit the various aircraft in the Air Force inventory and will be flight tested therein.

(2) Chemical Trail Development

Contractual and in-house.

A concurrent program will be run on the development of new materials for trail production. Special emphasis will be placed on the development of materials to give the maximum trail visibility for the smallest weight of material.

(3) Trail Visibility Physics

Contractual and in-house.

Work will be carried out on the determination of the optimum particle concentration, size, color, and trail shape for aircraft visibility purposes.

(4) Basic Anticollision Warning Devices

Contractual and in-house.

Studies will be carried out on an assessment of the various problems involved in aircraft collisions in an attempt to determine the measures which must be developed for an optimum warning system.

R&D PROJECT CARD
CONTINUATION SHEET

SECURITY CLASSIFICATION

1. PROJECT TITLE Aircraft Anticollision Trail Generators	2. SECURITY OF PROJECT Unclass.	3. PROJECT NUMBER 6666
	4.	5. REPORT DATE 3 November 1958

d. Other Information

(1) General

Hq. USAF - AFDRQ letter dated 25 Aug. 1958, subject: "Aircraft Artificial Contrail Generator" solicited requirements from USAF operational commands for such an anticollision device. Considerable interest was expressed in response to the letter by SAC, TAC, and ADC. This work should, in general, satisfy their requirements; close coordination will be maintained with these Commands to satisfy any special needs.

e. Background History

(1) The loss of aircraft and lives due to mid-air collisions represents a tremendous drain on Air Force resources. Studies have shown that a high percentage of collisions and near misses can be avoided if a device which gives visual indication of other aircraft operating in the vicinity can be developed.

(2) Work done on the development of missile tracking devices[2,3] gives some indication of the magnitude of the problem of producing trails which can be seen from great distances. Titanium tetrachloride appears to be the best material investigated thus far for the production of trails with a minimum weight of material. For aircraft use it is contemplated that the water produced in the exhaust will be used to hydrolyze the tetrachloride to visible titanium dioxide particles.

(3) Because aircraft trails must be visible from the air, not the ground, to act as an effective anticollision device, attenuation by the hazy lower atmosphere is not a problem and a trail will be much more visible.[4] This decreases considerably the weight of material necessary for visible trail formation.

f. Future Plans

No future plans beyond those outlined under Tasks (21c) are now available.

g. References

(1) "Mid-Air Collisions in the USAF," Directorate of Flight Safety Research, Office of the Inspector General, United States Air Force, Publication 15-57, 27 March 1957.

R&D PROJECT CARD
CONTINUATION SHEET

SECURITY CLASSIFICATION

1. PROJECT TITLE Aircraft Anticollision Trail Generators	2. SECURITY OF PROJECT Unclass.	3. PROJECT NUMBER 6666
	4.	5. REPORT DATE 3 November 1958

(2) "The Development of Chemical Smoke Tracking Aids," Final Report, Contract AF29(600)-869, Armour Research Foundation, 11 December 1957.

(3) "Study and Development of Phosphorous and Hydrogen Peroxide as a Chemical Tracking Aid," Final Report, Contract AF29(600)-908, Arthur D. Little, Inc., 31 October 1956.

(4) "Handbook of Geophysics for Air Force Designers," Chapter 14, Geophysics Research Directorate, Air Force Cambridge Research Center, 1957.

Item No. 18 Continued:

In the absence of Resources Summary Management Report, the estimates given in Item 18, Page 1, and in attached Form 116 indicate the following contract funds requirement:

	FY59	FY60
Airborne Generator Development	150M	100M
Chemical Trail Development	100M	100M
Trail Visibility Physics	50M	50M
Basic Anticollision Warning Devices	50M	50M
	350M	300M

h. Project Scientist

SEYMOUR J. BIRSTEIN
CRestview 4-6100, Ext. 136
Air Force Cambridge Research Center

DD FORM 1 FEB 53 613-1 PREVIOUS EDITIONS OF THIS FORM MAY BE USED.

SECURITY CLASSIFICATION